Design Worksheet and Charts for PVC Dry Fire Hydrant Installations.

The following worksheet and charts can be used to assist in the design of a dry fire hydrant installation. These charts will help determine the size of pipe and fittings that will be needed to flow at the capacity of the pumps being used at the hydrant site. The charts are for PVC pipe. Charts are available for other types of pipe material. Some factors to consider when designing the dry fire hydrant are:

(a) Static lift should not exceed 10 ft to 12 ft (3.1 m to 3.7 m), if possible. This is dead lift and cannot be overcome by enlarging the pipe size. Keep the static lift as low as possible.

(b) Total head loss should not exceed 20 ft (6.1 m), or the pump might not supply its rated gpm (L/min). If using portable pumps on the dry fire hydrant, keep total head loss as low as possible.

How to use the charts:

(a) Add the total length of straight pipe to be used at the site (screen + lateral run + riser = STRAIGHT PIPE). Write this down on the design worksheet at step 1.

(b) Using Figure 2, add up the number of feet of straight pipe equivalent for all fittings used to make up the hydrant (elbows + hydrant adapter + any reducers = STRAIGHT PIPE EQUIVALENT FOR FITTINGS). Write this down on the design worksheet at step 2.

(c) Add the numbers from step 1 and step 2 together to obtain the TOTAL STRAIGHT PIPE EQUIVALENT of the hydrant. Write this figure down on the design worksheet at step three.

(d) Determine the desired maximum gpm (L/min) hydrant flow. Usually this would be the pumping capacity of the pump or pumper used at this hydrant. Write this figure down on the design worksheet at step 4.

(e) Using Figure 3, determine the head loss due to friction per 100 ft (30.5 m) of pipe (number from step 3) based on the gpm (L/min) from step 4. If there is over or under 100 ft (30.5 m) of pipe equivalent (from step 3), adjust head loss from the chart. Example: TOTAL STRAIGHT PIPE EQUIVALENT is 75 ft (22.9 m) and the desired volume is 1950 gpm (7441 L/min) - head loss from the chart is 20 ft/100 ft (6.1 m/30.5 m) of pipe. For this run, there would be a head loss of 15 ft (4.6 m) [20 ft (6.1 m) × 75 ft/100 ft (22.9 m/30.5 m) = 15 ft (4.6 m)]. Write this figure down as HEAD LOSS FOR PIPE AND FITTINGS on the design worksheet at step 5.

(f) From Figure 4, figure the head loss due to friction in the suction hose to be used on the hydrant. Write down on the design worksheet as SUCTION HOSE HEAD LOSS at step 6.

(g) Next, determine static lift. This is the vertical distance from the water's surface in the hydrant pipe (use the lowest water level as it will represent the maximum lift needed) at the pump or pumper intake. Write this figure down on the design worksheet as STATIC LIFT at step 7. Try not to exceed 8 ft to 10 ft (2.4 m to 3.1 m) if possible. Remember - this is a vertical measurement and represents "dead" lift.

(h) Next determine the head loss through the strainer as shown by Figure 5 and 6,7 or 8 as appropriate.

(i) Add the answers from steps 5, 6, 7 and 8 together on the design worksheet at step 9. This is the TOTAL HEAD LOSS. Do not exceed 20 ft to 25 ft (6.1 m to 7.6 m) of total head loss at the pump intake; otherwise, all the pump capacity will be used for suction (or lift), and the pump might not flow its rated capacity.

Design Worksheet

FIRE DEPARTMENT _____

DRY FIRE HYDRANT LOCATION _____

Step 1

Strainer length _____

Lateral run length _____

Riser height _____

Straight Pipe = _____

Step 2

Use figure 2 to fill in the following values:

Hydrant adapter _____ Reducer _____

Elbow _____ Elbow _____

Elbow _____ Elbow _____

Straight Pipe Equivalent for Fittings = _____

Step 3

Straight Pipe + Straight Pipe Equivalent for Fittings = _____ + _____ = Total Straight Pipe Equivalent

Step 4

Desired GPM flow = _____ (Rated pump capacity)

Step 5

Using answers from step 3 and 4, use Figure 3 to determine Head Loss for Pipe and Fittings.

Head Loss for Pipe and Fittings = _____ per 100 foot X $\frac{\text{_____}}{100}$ feet = _____ feet

Step 6

Using Figure 4, determine suction hose head loss for length of suction hose used to connect the pump to the hydrant. Suction Hose Head Loss = _____ foot for _____ foot long suction hose.

Step 7

Static Lift = _____

Step 8

Strainer Loss = _____

Step 9

Add the answers from Steps 5, 6, 7 and 8 together to get total head loss.

#5 _____ + #6 _____ + #7 _____ + #8 _____ = Total Head Loss

If Total Head Loss is greater than 20 to 25 ft, the pump might not be able to flow its rated GPM.

Figure 1 Design Worksheet

PVC Pipe Diameter	2.5"	3.0"	4.0"	5.0"	6.0"	8.0"	10.0"
90° Elbow, Standard	6.5	8.5	11.0	14.0	16.0	22.0	27.0
90° Elbow, Medium Sweep	5.5	7.0	9.5	12.0	14.0	18.0	22.0
90° Elbow, Long Sweep	4.5	5.5	7.0	9.0	11.0	14.0	18.0
45° Elbow	3.0	4.5	5.0	6.5	7.5	10.0	13.0
Hydrant Connection (6" x 4.5")					2.5	2.5	2.5
Reducer (8" x 6") or (10" x 6")						3.5	8.0

Figure 2, Straight Pipe Equivalent for Fittings (in feet)

Pipe Size	3"	4"	5"	6"	7"	8"	10"
GPM							
100	2.4	0.6	0.2	0.1			
200	8.6	2.1	0.7	0.3	0.1	0.1	
250	13.0	3.2	1.1	0.5	0.1	0.1	
300	18.2	4.5	1.5	0.6	0.2	0.2	0.1
350	24.2	6.0	2.0	0.8	0.3	0.2	0.1
400	30.9	7.6	2.6	1.1	0.4	0.3	0.1
500	46.8	11.5	3.9	1.6	0.8	0.4	0.1
600	65.6	16.2	5.5	2.2	1.1	0.6	0.2
700	87.2	21.5	7.3	3.0	1.4	0.7	0.2
750	99.1	24.4	8.3	3.4	1.6	0.8	0.3
800	111.7	27.5	9.3	3.8	1.8	0.9	0.3
900	138.9	34.3	11.6	4.8	2.3	1.2	0.4
1000	168.8	41.6	14.1	5.8	2.7	1.4	0.5
1100	201.4	49.7	16.8	6.9	3.3	1.7	0.6
1200	236.7	58.4	19.7	8.1	3.8	2.0	0.7
1300	274.5	67.7	22.9	9.4	4.4	2.3	0.8
1400	314.9	77.7	26.2	10.8	5.1	2.7	0.9
1500	357.7	88.5	29.8	12.3	5.8	3.0	1.0
1600	403.2	99.5	33.6	13.8	6.5	3.4	1.2
1700	451.1	111.3	37.6	15.5	7.3	3.8	1.3
1800	501.5	123.7	41.8	17.2	8.1	4.2	1.4
1900	554.3	136.7	46.1	19.0	9.0	4.7	1.6
2000	609.5	150.4	50.8	20.9	9.9	5.2	1.7
2100	667.2	164.6	55.6	22.9	10.8	5.6	1.9
2200	727.2	179.4	60.6	24.9	11.8	6.2	2.1
2300	789.6	194.8	65.8	27.1	12.8	6.7	2.3
2400	854.4	210.7	71.2	29.3	13.8	7.2	2.4
2500	921.4	227.3	76.7	31.6	14.9	7.8	2.6
2600	990.9	244.4	82.5	34.0	16.1	8.4	2.8
2700	1062.6	262.1	88.5	36.5	17.2	9.0	3.0
2800	1136.6	280.4	94.7	39.0	18.4	9.6	3.2
2900	1213	299.2	101.0	41.6	19.7	10.3	3.5
3000	1291.6	318.6	107.6	44.3	21.0	10.9	3.7

Based on Hazen-Williams Formula

Figure 3, Head Loss (ft per 100 ft of PVC pipe)

The Charts are for PVC schedule 40 pipe. Other types of pipe material have similar charts that should be consulted when other pipe is used.

Hose Size	1 1/2"	2 1/2"	4"	4 1/4"	5"	6"
GPM						
100	84.1	7.0	0.7	0.4	0.2	0.1
200	303.6	25.3	2.6	1.4	0.9	0.4
250	459.0	38.2	3.9	2.2	1.3	0.5
300	643.3	53.6	5.4	3.1	1.8	0.8
350	855.9	71.3	7.2	4.1	2.4	1.0
400	1096.0	91.3	9.3	5.2	3.1	1.3
500	1656.9	138.0	14.0	7.9	4.7	1.9
600	2322.4	193.4	19.7	11.1	6.6	2.7
700	3089.7	257.3	26.1	14.7	8.8	3.6
800	3956.6	329.5	33.5	18.9	11.3	4.7
900	4921.0	409.9	41.6	23.5	14.1	5.8
1000	5981.4	498.2	50.6	28.5	17.1	7.0
1100	7136.1	594.4	60.4	34.0	20.4	8.4
1200	8383.8	698.3	71.0	40.0	24.0	9.9
1300	9723.5	809.9	82.3	46.4	27.8	11.4
1400	11153.9	929.0	94.4	53.2	31.9	13.1
1500	12674.2	1055.6	107.2	60.5	36.2	14.9
1600	14283.3	1189.6	120.9	68.1	40.9	16.8
1700	15980.5	1331.0	135.2	76.2	45.7	18.8
1800	17765.0	1479.6	150.3	84.7	50.8	20.9
1900	19635.9	1635.5	166.2	93.7	56.1	23.1
2000	21592.7	1798.8	182.7	103.0	61.7	25.4
2100	23643.7	1968.5	200.0	112.8	67.5	27.8
2200	25761.2	2145.7	218.0	122.9	73.6	30.3
2300	27971.7	2329.8	236.7	133.4	80.0	32.9
2400	30265.7	2520.8	256.1	144.4	86.5	35.6
2500	32642.5	2718.8	276.2	155.7	93.3	38.4
2600	35101.9	2923.7	297.0	167.5	100.3	41.3
2700	37643.1	3135.3	318.5	179.6	107.6	44.3
2800	40265.8	3353.8	340.7	192.1	115.0	47.4
2900	42969.6	3579.0	363.6	205.0	122.8	50.6
3000	45753.9	3810.9	387.1	218.3	130.7	53.8

For SI units: 1 GPM = 0.0631 L/sec.

Figure 4, Head Loss (ft per 100 ft of hard rubber suction hose)

Head Loss Through Strainer

Open Area = 4 times Pipe area = $4 \times \frac{TT}{4} (D)^2 = TT\ D^2$

D = Nominal Pipe Size and is considered inside diameter for these computations.

Pipe Size (Inches)	Open Area (Square Inches)	Number of 3/8" holes	Number of 1/2" holes
6"	113.1	1026	---
8"	201.1	1821	1026
10"	314.2	---	1600

Figure 5, Strainer Open Area

Q = Desired flow rate in gpm.

d = hole diameter (inches)

$$q = \frac{Q}{\text{number of holes}} = \left(\frac{gpm}{hole}\right)$$

$$\text{Head Loss of Strainer} = \left[\frac{\frac{q}{60 \times 7.5}}{0.6 \times 8.02 \times \frac{TT}{4}\left(\frac{d}{12}\right)^2}\right]^2$$

Desired Flow Rate	Number of 3/8" holes	Head Loss
250	1026	0.02
500	1026	0.09
750	1026	0.19

Figure 6, Head Loss for Six inch Pipe Strainer 5 feet long

Desired Flow Rate	Number of 3/8" holes	Head Loss	Number of 1/2" holes	Head Loss
250	1821	0.01	---	
500	1821	0.03	---	
750	1821	0.06	1026	0.06
1000	1821	0.11	1026	0.11
1250	1821	0.18	1026	0.17
1500	1821	0.25	1026	0.25

Figure 7, Head Loss for Eight inch Pipe Strainer 5 feet long

Desired Flow Rate	Number of 1/2" holes	Head Loss
250	1600	0.01
500	1600	0.01
750	1600	0.03
1000	1600	0.05
1250	1600	0.07
1500	1600	0.10

Figure 8, Head Loss for Ten inch Pipe Strainer 5 feet long

Installation Procedure for Dry Fire Hydrant.

(a) Check for any underground or overhead utilities before digging. Contact the appropriate authorities, e.g., water, power, telephone, cable, gas, etc.

(b) Using a backhoe or excavator, dig in the trench starting at the point where the suction screen will be placed in the water.

(c) Maintain a uniform level trench cut all the way from the screen location to the point where the riser begins.

(d) Assemble the horizontal run and vertical riser portion of the hydrant (screen, lateral run, and riser) and place into the trench and water source as one piece.

(e) Sink the screen end and allow the assembly to sink into the bottom of the trench. **IT IS CRITICAL THAT AT NO TIME SHOULD ANYONE BE ALLOWED INTO OR CLOSE TO THE TRENCH. IT IS NOT NECESSARY.**

(f) When certain the suction screen is placed correctly, start backfilling the trench at the riser (keeping the riser pipe vertical) and backfill out into the water, being careful not to cover the suction screen.

(g) Mound and tamp the dirt slightly, as settling will occur over time. Mounding the dirt will also help keep frost away from the water in the pipe.

(h) Place a cement block or use a commercial or manufactured strainer support under the suction screen to support the screen off the bottom. If the installation is in a fast-moving waterway, several blocks or supports might have to be attached to the screen to prevent the current from moving the screen. The pipe and screen will also have to have special protection from any debris washing down the stream and hitting the pipe or screen.

(i) Cut off the vertical riser and attach the hydrant connection, making sure that the top of the hydrant connection is below the bottom of the pump intake. It is important that the pump intake remain slightly above the hydrant connection to prevent an air lock in the suction line.

(j) Set up guards and hose supports. Level, seed, and mulch the area to prevent erosion.

(k) Test pump the hydrant.